FEEDING, GROWTH AND EARLY DEVELOPMENT OF THE INDIAN TROUT, *BARILIUS* (*OPSARIUS*) *BOLA* HAM.[1]

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(*With five text-figures*)

Study of feeding habits, growth and early development of the Indian trout, *Barilius* (*Opsarius*) *bola* Ham. which was introduced in the Lonavla lakes near Poona, indicates that it is a carnivorous fish thriving largely on small fish such as *Rasbora, Chela, Oxygaster, Danio,* etc. In lakes it grows to about 620 g. in 27 months and breeds in the third year. The male develops rough, tubercled scales on the sides and bright coloration on fins during breeding season which begins early in the monsoon.

On hypophysation and stripping, the fertilised eggs took about 65 hours to hatch. The hatchlings had medium sized yolk sac and were comparatively more active than those of major carps and started swimming very soon. The post-larva developed chromatophores only on the fourth day and started feeding on minute *Moina* etc. On the seventh day it reached 8 mm length and on 18th day a well-grown 18 mm fry stage.

INTRODUCTION

Barils or the Barilius group comprising mostly small sized fish have scarcely attracted the attention of fishery biologists in the past. Chacko (1945) wrote a short note on *B. bendelisis,* a tiny form hardly weighing 20 g. when full grown and 12 cm in total length. Day (1878) referred to Indian trout as *Barilius bola* Ham. but Hora (1937) reviewing the taxonomic position of the fish, preferred to call it *Barilius* (*Opsarius*) *bola* Ham. It is the largest species among the group *Barilius* and attains 1.5 kg in weight. It is quite outstanding for several reasons; yet except for a few notes about its angling qualities by Thomas (1897) and Macdonald (1948) and about its suitability for introduction in Lonavla lakes (Evans 1926) and in Peninsular India by Spence & Prater (1932), very little has been said about the breeding habits or early life history of this fish. It was not recorded from anywhere south of the Vindhya hill range in India till its introduction in the Walwhan lake of the Tata Electric Co. at Lonavla, District Poona (Kulkarni 1975). This introduction enabled recording of some of the observations made on this fish and very recently, it could be bred, with the help of pituitary harmone. The eggs and early stages thus obtained are described below.

FEEDING, GROWTH AND BREEDING

Unlike the feeding habits of most of the members of the Cyprinoid group, the *B. bola* is largely a piscivorous form, rejecting all inanimate food in the natural environment. It is largely a riverine fish, frequenting shallow marginal waters for hunting small fish life. In lacustrine conditions, it inhabits the upper columns of the lake waters and feeds voraciously on small live fish such as *Rasbora, Chela, Oxygaster* and *Danio,* but it studiously

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avoids any dead ones among them even in small ponds. This endorses the presumption made by Hora (1937) that "the form and structure of its alimentary canal leaves no doubt that it is a highly carnivorous species". Groundnut cake which is liked by most of the carps is disdained by this fish; neither does it take any green algae in the water. However, the rapacious nature of the fish indicates that it might take to artificial feed of animal origin after certain amount of training, as is found in the case of Murrels.

As regards the rate of growth, no data are available based on commercial catches but it can be stated that the fish could grow to about 620 g in 27 months in the large open water of Walwhan lake, which has a water spread of 556 ha. This growth is based on the actual recoveries of specimens from the lake which was stocked with fingerlings obtained from tributaries of Chambal river in northern India in 1974 (Kulkarni 1975).

Breeding: From observations which have been reliably reported, the fish approaches running streams for the purpose of breeding in the early months of the monsoon (June) but prefers quieter inundated areas by the side of such freshets for spawning where they were actually seen in nuptial movements. A pair which was captured contained ripe eggs and oozing milt; they would have probably spawned in that area had they not been roughly handled by their captors. This habit of approaching freshets shows considerable similarity between them and other large carps like Rohu, Mrigal etc. Taking into consideration its age at the time of introduction, the fish can be said to breed in the third year of its age and in the early part of the monsoon, the aforesaid mature pair of fish having been encountered in the last week of June 1977. Chacko (loc. cit.) reports breeding of *B. bendelisis* from July to December in tributaries of Krishna and Cauvery.

In respect of secondary sexual characters in *B. bola,* there are no structurally clear cut differences, but in the male, scales on the sides of the body, particularly the posterior half of it become rough during the spawning season; so much so that it enables distinguishing the sexes by mere touch and without removing the fish out of the water. The roughness was found to be due to a wart like concretion in the middle of the exposed part of the scale (fig. 1) and it disappears after the spawning

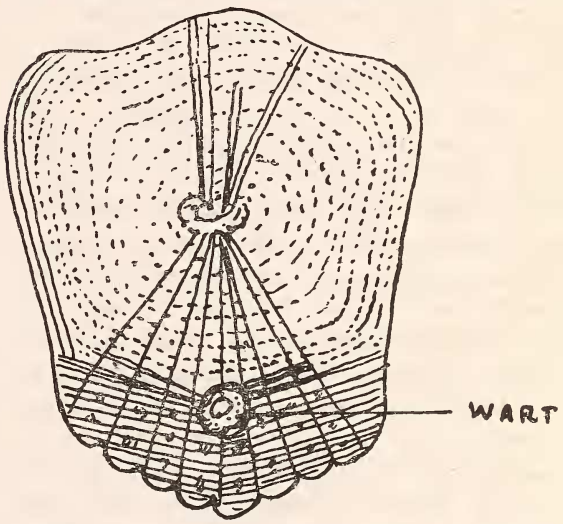

Fig. 1. Scale from male *Barilius* (*Opsarius*) *bola.*

season. Secondly, the outer rays of the lower lobe of the caudal fin are distinctly pink in colour in the male while they are of lighter shade in the female. The pectoral, pelvic and anal fins are yellowish orange in the male and lighter in female. Further the dark spots on the opercles are much more prominent in the male. In short, like many other animals the male shows his best colouration during this season. In the case of *B. bendelisis* also the

males are reported to be more brightly coloured and have tiny tubercles on both jaws (Chacko, op. cit.), but no rough scales on the body are mentioned.

Some of the Indian trouts were grown in a pond for ascertaining whether they would breed naturally like *Cyprinus carpio*. This expectation was, however, belied, though two females weighing 400 gm appeared spent in the first week of July. The remaining three females though they were small in size, being hardly between 260 and 300 gm in weight and in the second year of their age were injected with extracts of pituitary glands at the rate of 2 mg per kg of body weight at 7 a.m. on 8-vii-1977. The first injection was followed by a second one at 4 mg per kg body weight, four hours after the first injection. The males were given only one dose of 2 mg per kg per body weight along with the second injection to the females and the both sexes put together in the breeding enclosure (hapa). Temperature of water varied between 21° and 22°C as intermittent showers and cloudy skies continued all along. As no natural spawning occurred even after seven hours after the second injection, the females were stripped by dry method and the eggs fertilised with the help of milt similarly obtained from the males. After washing the eggs in the usual manner, they were found to be absorbing water and also indicating normal fertilisation, thus ensuring success in breeding the Indian trout artificially, for the first time.

Eggs and early development

Eggs: The egg of the Indian trout, when freshly laid is about 1.5 mm and on absorbtion of water is 2.8 mm in diameter (Fig. 2a). Being slightly heavier than water it settles at the bottom in still water but with slightest disturbance or movement it moves along with the water like the eggs of other large carps (Rohu, etc.). It is spherical and almost transparent except at the yolk portion which is dull creamy in colour. The perivetelline space is somewhat narrow as compared to that in the large carps.

The eggs were observed at an interval of every four hours in the early stages. They passed through the usual cell divisions and the blastula stage, including the elevated blastoderm on the germinal pole of the yolk mass which flattens later on and gives rise to the embryonic shield and also the cephalic groove (Fig. 2b, c, d).

At 18 hrs, the development of the embryo had progressed considerably, the size of the yolk mass reduced and the cephalic area and tail end became distinct thus representing a coma shaped stage (Fig. 2d). The temperature of water in which the eggs were hatched varied from 26 to 28°C.

At 24 hrs, the head region seems to have developed fairly fast; the optic vesicles were seen and also a few myotomes in the body region. The yolk mass had been further absorbed and the tail end had been free. At intervals slight movement of the embryo was also perceptible within the eggs. The stage of development in all eggs of the same batch was not the same, some having lagged behind even in the same water temperature.

At 36 hrs, the yolk mass was further reduced and the development of the embryo progressed internally in respect of additional myotomes, cerebral lobes and other organs. The embryo started twitching and moving within the egg shell, the rate of such movement being as much as 30 to 38 times per minute. However, at this stage the development became considerably uneven in other eggs of the same lot.

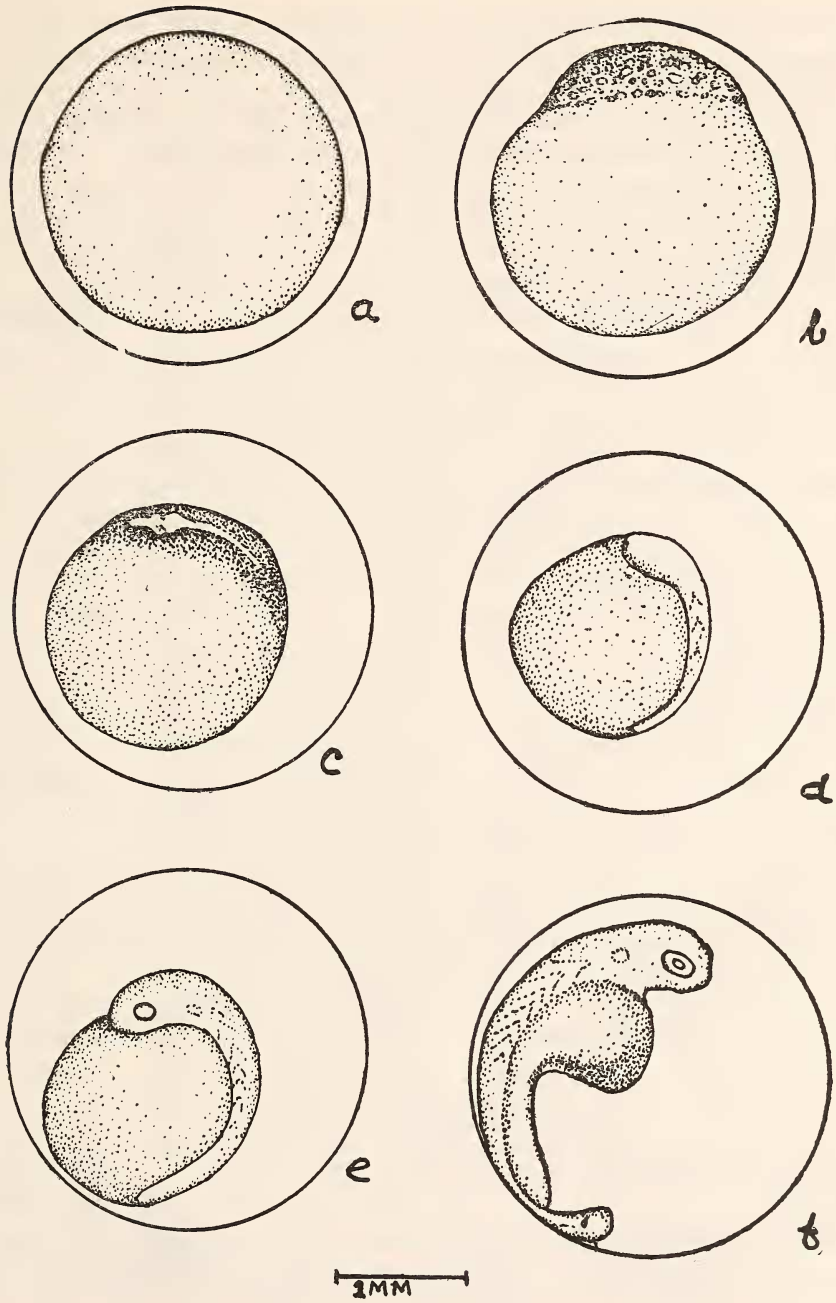

Fig. 2. a. Newly fertilised egg of Barilius (*Opsarius*) *bola* Ham.
b-f. Developing stages of eggs of *B.* (*O.*) *bola* (Ham.)

At 42 hrs, the twitching action of the body of embryo continued vigorously. The head region and the cerebral lobes had developed distinctly. The optic vesicles and the optic lens were clearly visible but no chromatophores were perceptible. The muscle segments and the yolk sac of the embryo with its anterior rounded portion and the posterior tubular portion and also the caudal lobe were clearly observable. The heart tube was indistinctly seen and as the demarkation was not clear, pulsation of the heart had not commenced. However, after three hours heart formation became apparent and feeble pulsation could be watched. The eyeball was distinct and glistening, but no pigment was seen. The optic capsules had developed though otoliths were yet absent. For better oxygenation of water the eggs were kept in a petridish, with an electric fan kept going all the time. This had also helped in maintaining the temperature of water at 26°C. The embryo continued to develop its organs and to wriggle around within the egg case with moderate jerking movements of the tail.

At 11 a.m. on 11-vii-1977, i.e. 64 hours after it was fertilised one of the eggs hatched into first hatchling or a larva with a prominent yolk sac (fig. 3). It measured 5 mm in total length, whitish grey in colour, with double lobed yolk sac slightly silver grey. The anterior portion of the yolk sac though rounded was a slightly oblong while the posterior one was more elongated with a wide notch or constriction between the two. The length of the yolk sac (both lobes) was almost half of the total length of the larva. The rudiments of jaws were indistinctly perceptible.

The black pigment in the eyes had fully developed. The eyes appearing distinctly large and black. Similarly the heart also was fully formed and pulsating and the blood corpuscles had become red as usual. Auditory capsule with otoliths in them were perceptible. No large chromatophores were seen on the head or the body except a row of small elongated dash like black pigmented streaks above the dorsal side of the yolk sac. Very thin pectoral fin fold was seen with no rays in it. The vertical median fin fold starts dorsally slightly anterior to the mid point of the yolk sac and continues around the caudal end, terminating near the position of the anal opening. Second vertical fin fold is seen on the posterior portion of the yolk sac and proceeds backwards to end near the expected anal opening. As compared to the hatchlings of other large carps which are rather semi quiescent, settling at the bottom and only occasionally twitching and wriggling, the hatchling of the Indian trout is more developed and starts swimming about as soon as it is hatched. The earlier helpless condition common in large carps is probably passed in this case in the egg stage itself.

After about 30 hours of hatching, i.e. on the second day, the length of the hatchling had not extended beyond 6.2 mm but jaws which were rudimentary were well formed and even moveable. The eyes had become more prominent with a well formed pale golden ring around the lens. The heart was vigorously pulsating and the division between the anterior and posterior portions of the yolk sac had further progressed leading to a constriction. The anterior one shorter and the posterior elongated. The tail end is slightly up turned. There were yet no chromatophores on the head or the body, except the small fine dots on the upper side of the yolk sac.

On the fourth day, the hatching becomes quite active and the movements of its jaw indicated its attempts to feed on small food particles. Small sized *Moina* sp. sifted through a strainer was supplied to these hatchlings and it was found that they did attack

them and thus feed on them. The hind gut had also developed along with its opening. The pectoral fin fluttered actively. At this stage large chromatophores had developed on the head and dorsal portion of the body above the pectoral and a few behind it. Smaller melanophores were seen above the anterior portion of the yolk sac which was considerably reduced in size, its posterior portion had almost been tube-like and functional.

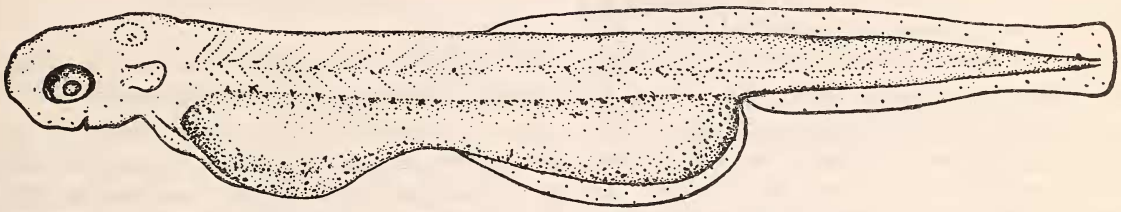

Fig. 3. Newly hatched larva (hatchling) of *B.* (*O.*) *bola* Ham.

disappeared and portion of intestinal tube was visible so also a small air bladder. The dorsal and caudal fin folds were developing fin rays but there were no traces of anal or pelvic fin rays. The preanal fin fold was also reduced in size. The fry continued to feed on sifted *Moina* and moved about elegantly.

On the seventeenth day, the fry (fig. 5) had reached total length of 18 mm with all the fins well developed. The body continued to be

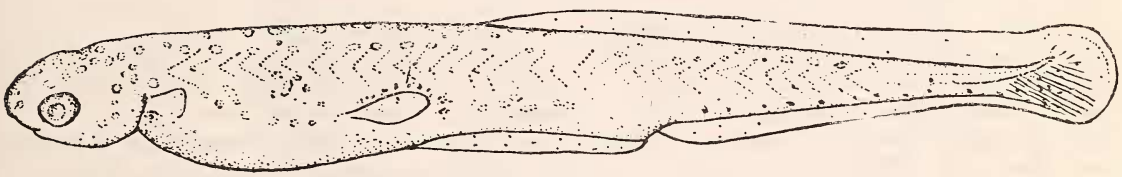

Fig. 4. Seven day old fry of *B.* (*O.*) *bola* Ham.

On the seventh day, the hatchling (fig. 4) had almost become a tiny fry of 8 mm length. The body was covered with large number of chromatophores right from the head to the tail portion. The yolk sac had completely covered with melanophores scattered all over as in the earlier stage. They appeared even on the caudal fin-rays and a part of the caudal peduncle. The nature of the jaws, prominent eyes and sleek elongated body were character-

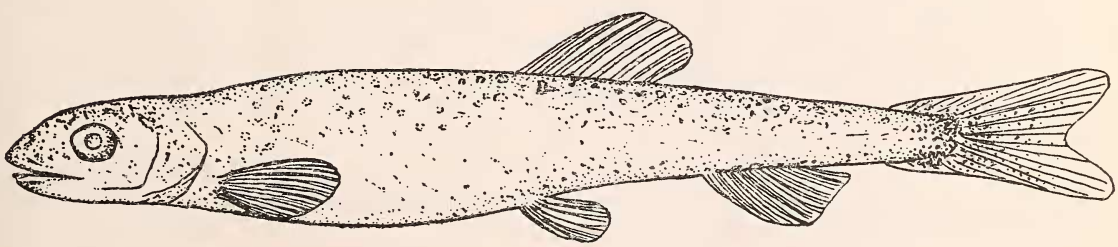

Fig. 5. Seventeen day old fry of *B.* (*O.*) *bola* Ham.

istic of the adult Indian trout. However, it is felt that the large number of melanophores seen at this stage may be due to captive condition and is likely to be much less in natural open bodies of water.

It was seen that the rate of development of embryos was different in individual cases. Although the first egg hatched out in 64 hrs, other eggs in the same batch took 68 to 72 hours in water of 26°C. Further, the eggs which were being hatched in floating trays with continuous sprinklers of water of 21° - 22°C at Lonavla (Walwhan) hatchery, the hatching period varied from 58 to 68 hours, some of them taking even longer time. In these floating trays a large number of eggs perished on account of some unidentified infection. Hence 68 hours can be taken as average hatching period. It was further seen that these eggs were more delicate than the eggs of other carps and easily susceptible to disease.

Acknowledgements

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References

Chacko, P. I. and Venkataraman, R. S. (1945): On the Bionomics of the Baril, *Barilius bendelisis* (Ham.). *J. Bombay nat. Hist. Soc. 45*:438-439.

Day, F. (1878): Fishes of India.

Evans, F. (1926): Fishing in Lonavla. *J. Bombay nat. Hist. Soc. 31*:828-830.

Hora, S. L. (1937): The Game Fishes of India.

McDonald, A. S. T. J. (1948): Circumventing the Mahseer and other sporting fish in India. Bombay Natural History Society, Bombay.

Spence, R. and Prater, S. H. (1932): Game Fishes of Bombay and neighbouring Districts. *J. Bombay nat. Hist. Soc. 36*:29-66.

Kulkarni, C. V. (1975): Introduction of Indian trout in Lonavla waters. *J. Bombay nat. Hist. Soc. 72*:572-575.

Thomas, H. S. (1897): The Rod in India, London.